Purpose: The goal of this project is to create an Automated Transport Vehicle (ATV) which can independently carry cargo, reducing bodily strain on the user.

Requirements	**Specifications**
Robot Construction	
Must support a carry-on suitcase	- Minimum size of cargo area: 22x14x9 inches based on TSA/airline carry-on bag size - Carry maximum load of 20 pounds, with a factor of safety of 1.5
Must be lightweight	- Weigh less than 30 lbs
Cargo must be secure	- Cargo area must be enclosed and openable - Cargo and robot body must be able to withstand impacts of and remain undamaged by 200 N (a kick)
Must have a mobile power source	- Power system components for a minimum of 1 hour
Water Resistance	- Must be able to qualify for an IP 21 rating
Must be safe to use	- Must close with no more force than 2 Nm to prevent injury to user
Cameras must be protected	- Cameras will be in watertight containment unit, protecting them from impacts and environmental threats
Environmental Constraints	
Must be able to navigate through GW campus environment	- Fit through standard 36” door frame - Climb standard 6” curb while carrying load - Climb maximum incline of 30° - Cargo must remain secure when max incline and/or max speed are reached
User must be able to navigate normally throughout environment	- Follow user moving at a speed up to 5 mph
Object Identification	
Must distinguish user	- Minimum FOV of the camera must be 90° in the vertical direction given working distance of 6 feet - Identify and track original user in all

	situations including: 1) Obstacles in between user and ATV 2) User exits camera's field of view
Must be able to categorize obstacles	- Distinguish between objects that are climbable versus ones that require a route modification
User Interface	
Must be easy to operate	- Loading cargo and running device should each be 1-command operations

Scope:

The automated transport vehicle (ATV) will hold and carry the belongings of individuals with a physical impairment that restricts his/her ability to do so. The ATV will follow the user around the George Washington University campus via on-board cameras. It will be comprised of two main parts: a rectangular crate and motorized base. Two cameras will be attached to the crate and will able to detect a single user, as well as determine the location of the user with depth-tracking abilities.

The base of the ATV will be a rocker-bogie mechanism, similar to that of the Mars rover. This design was chosen as it has a flexible suspension system allowing it to move over curbs and sidewalk imperfections with relative ease. The ATV will be able to traverse over standard roadside curbs, but will not be able to climb over stairs. The carrying crate will be large enough to hold a standard-sized carry-on luggage. The whole system will be able to withstand impacts of 200 N, the force of kick by a professional soccer player. All components of the ATV will be water resistant.

The ATV will have object-avoidance capabilities that enable it to continuously follow the user without user input. Similar to Google's self-driving car, the ATV will utilize a multitude of sensors to gauge the location and distance of obstacles. The sensors will be placed such that obstacles which can be traversed by the ATV will not be detected, so as to forego obstacle classification. When a non-traversable obstacle is determined, the user's last known location will be stored. During evasive maneuvering, user identification will briefly pause.